(12) UK Patent Application (19) GB (11) 2 129 034 A

172-4.5, 197 279, 44 5.1

(21) Application No 8312385
(22) Date of filing 5 May 1983
(30) Priority data
(31) 13/191712
(32) 29 Oct 1982
(33) Japan (JP)
(43) Application published
10 May 1984
(51) INT CL³
E02F 3/76 G05D 3/12
(52) Domestic classification
E1F 12A
(56) Documents cited
GB 1488202
GB 1375539
GB 1372272
GB 1344672
GB 1254645
GB 0728578
(58) Field of search
E1F
A1P

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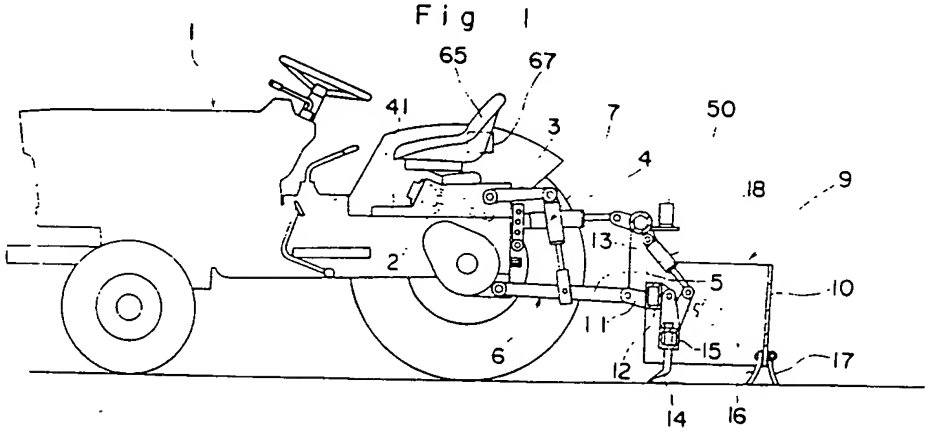
(54) Tractor with a scraper

(57) A seated-operator type tractor comprises a vehicle proper 1, equipped rearwardly thereof with a link mechanism 6 and a scraper 9 for ground-levelling. The vehicle 1 is further provided with a position-controlling mechanism 34 for controlling the up-and-down position of the scraper 9; an automatic control mechanism for maintaining the scraper 9 in its left-and-right horizontal posture, by means of a sensor 50 therefore; a control-valve for controlling blade-angle adjustment of the scraper 9; and a manual switch disposed near at hand to the seated operator, for shifting over the vehicle.

Fig 1



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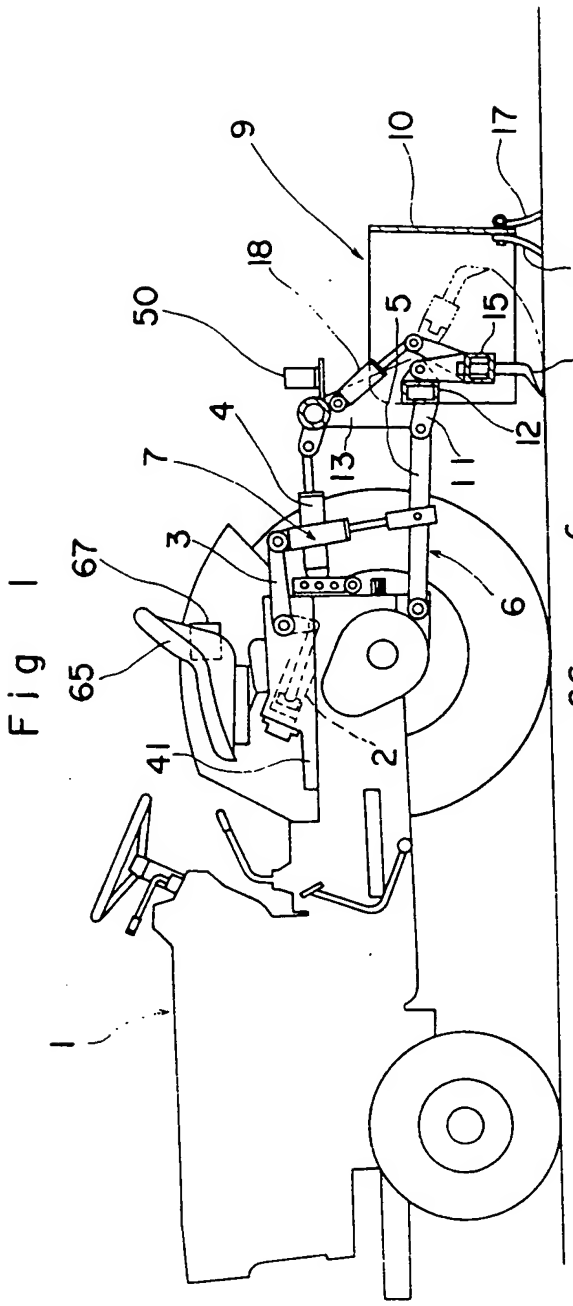
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Fig 1

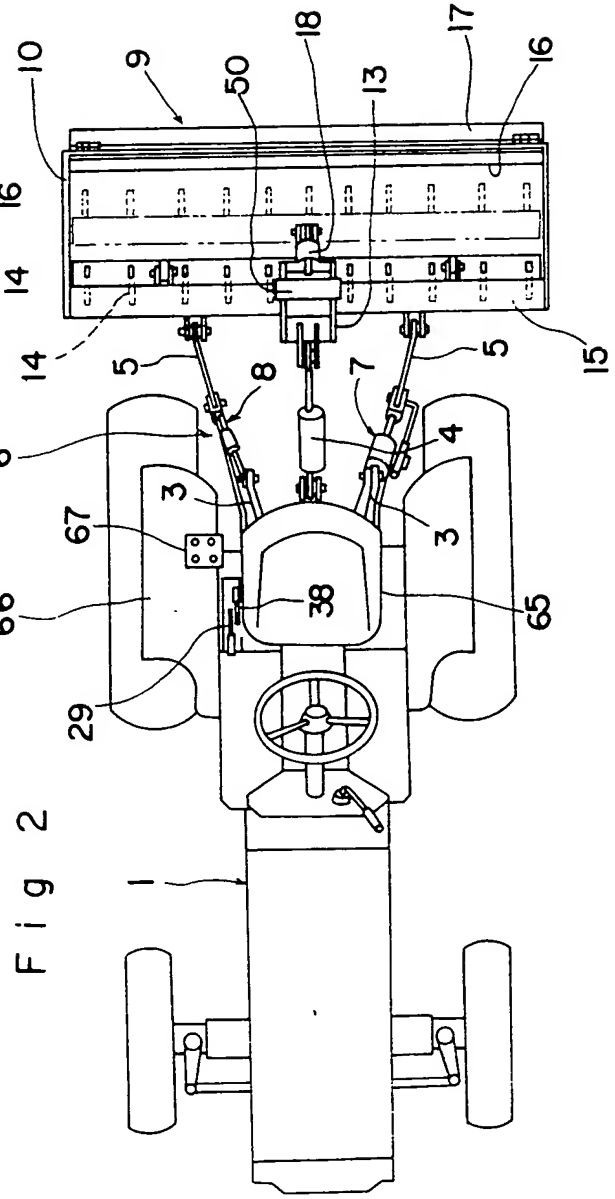
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Fig 2

Fig 3

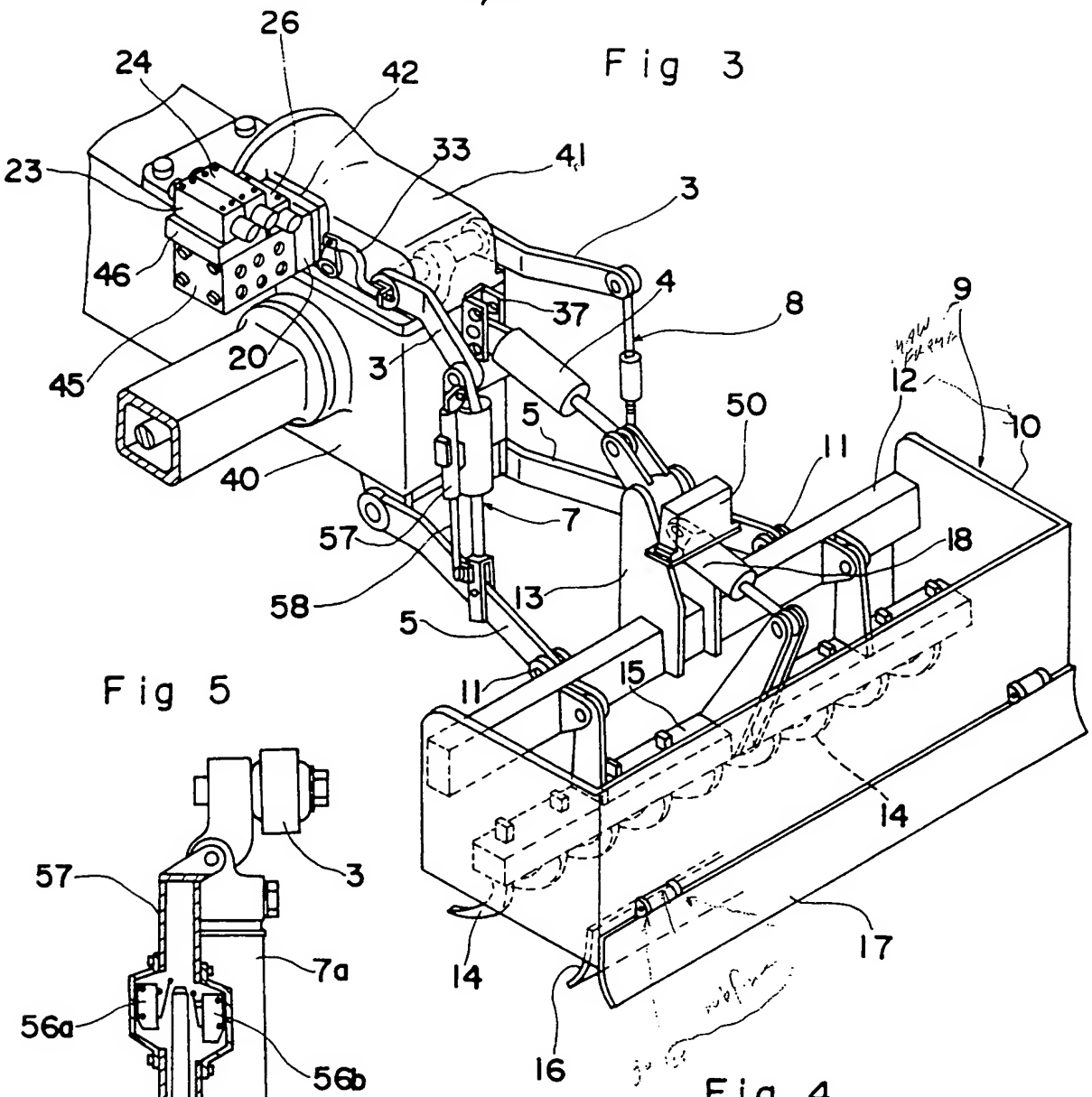


Fig 5

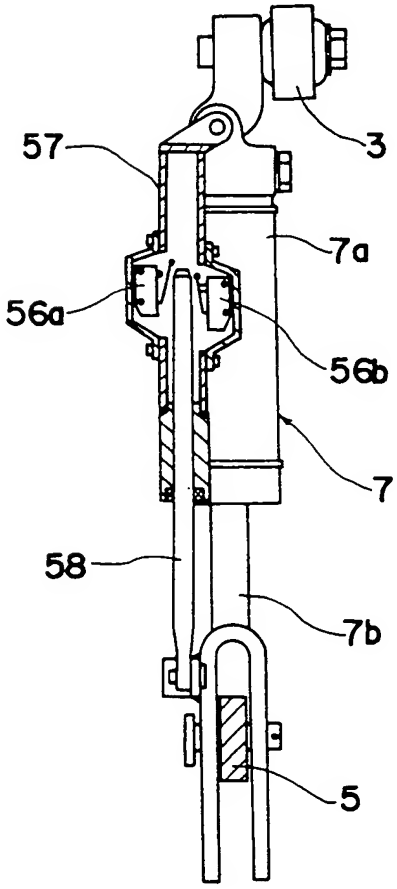


Fig 4

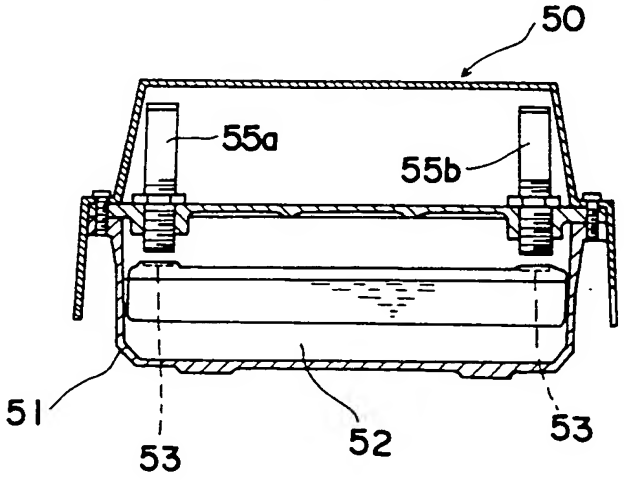
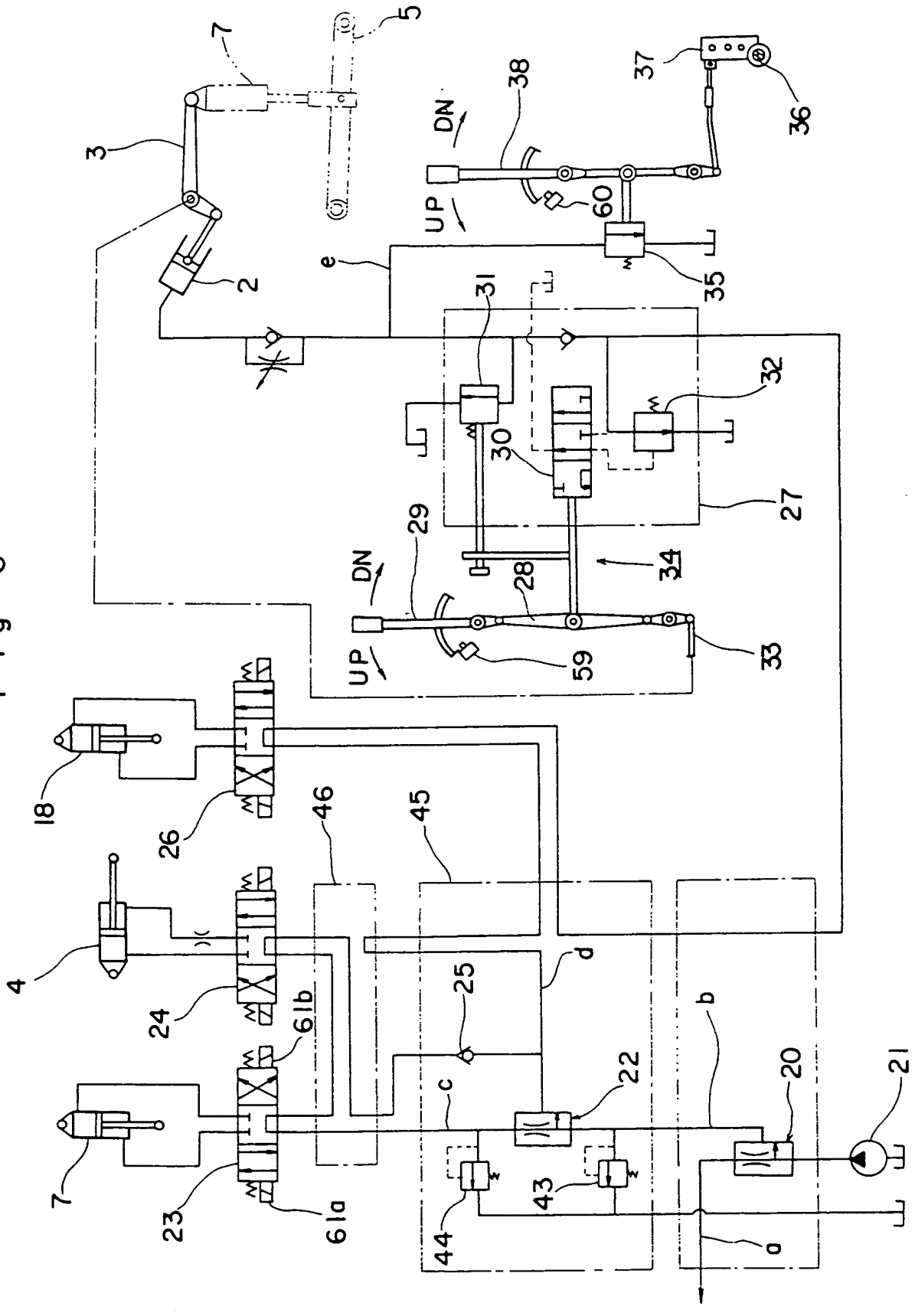


Fig 6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7
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DN
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36
35
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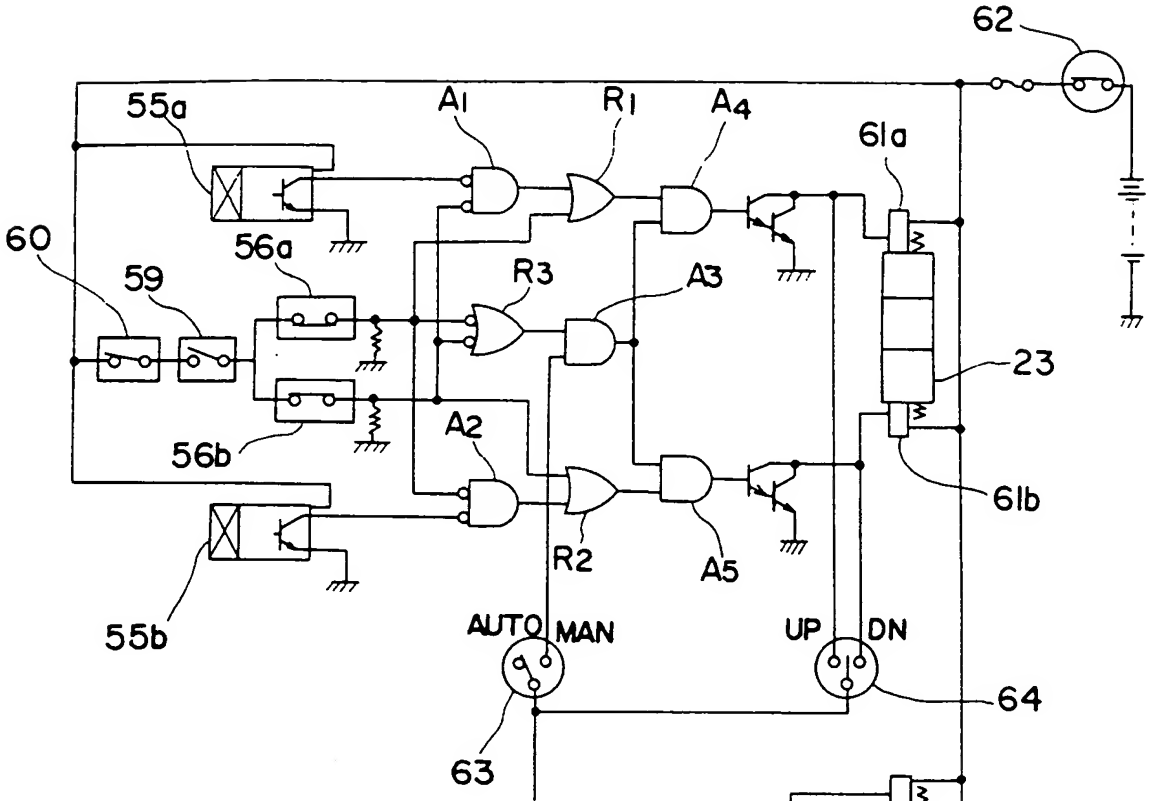
34
33
59
18
26
46
45
4
24
61b
25
d
b
22
20
21
c
7
23
61a
44
43
a

Fig 7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A1
R1
A4
61a
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56a
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R3
A3
23
56b
A2
61b
R2
A5
55b
AUTO
MAN
UP
DN
64
63
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47
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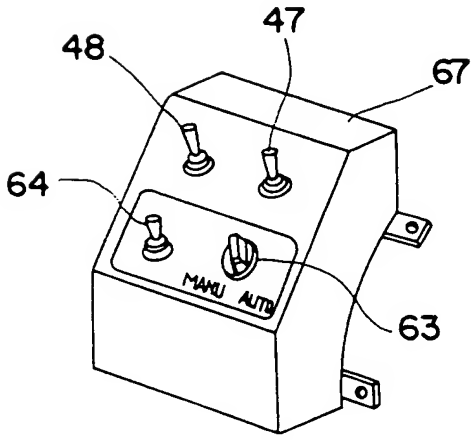
Fig 8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47
67
64
MANU
AUTO
63

SPECIFICATION
Tractor with a scraper

This invention relates to a seated-operator type tractor comprising a vehicle proper and a scraper. The vehicle is equipped, rearwardly thereof, with a link mechanism which is adopted for implement connection and which can be raised and lowered by means of oilhydraulic type lift arms; and a scraper, which is used for ground-levelling and which may be a structure even as simple as a substantial blade, which is connected to the link mechanism and is adapted to be subjected to rolling-adjustment by means of an oilhydraulic actuator and to have blade angles which are adjustable by means of another oilhydraulic actuator.

With such a tractor equipped with a scraper for ground-levelling of the structure as above, the ground-levelling work using the scraper has conventionally been difficult in its manoeuvring and has required skill to a considerable degree, in view of the fact that it has been common to control the oilhydraulic actuator for the adjustment with respect to rolling and the oilhydraulic actuator for the blade-angle adjustment, with respect to their actuation, respectively by means of manual type 3-position control valves. Therefore in order to adjust the working position and posture of the scraper and additionally thereto to manoeuvre, in raising and lowering, the lift arms, three kinds of manual manoeuvring have thus been imposed on the operator who must of course operate and steer the vehicle as well. Especially, level-finishing has been the most difficult step, such that even a skilled operator must repeat the treatment four or five times in order to attain satisfactory results, thus requiring considerable time in such finishing step which has therefore impeded the working efficiency.

This invention has as its object to provide a tractor with a scraper for ground-levelling with which even a relatively less-experienced operator can cope with the level-finishing by means of the scraper — that has thus conventionally been considered to be extremely difficult — with good precision and yet in a short time and with good efficiency.

Accordingly, the invention provides a tractor and a scraper of the type mentioned above, which further comprises:

a position-controlling mechanism which raises and lowers said lift arms to target positions corresponding to manoeuvred positions of a position-controlling lever disposed near at hand to the seated operator and which causes same to automatically halt upon reaching the target positions;

a sensor adapted to detect left and right slant postures of the said scraper or the vehicle;

an automatic control mechanism which actuates, according to the detection results of the sensor, the oilhydraulic actuator for the adjustment with respect to rolling and thereby maintains the scraper in its left-and-right horizontal posture;

a control valve which controls the oilhydraulic actuator for the blade-angle adjustment; and

a manoeuvring means disposed near at hand to the seated operator for manoeuvring the control valve from the operator's seat.

Thus the improved tractor relieves the operator from the manoeuvring for the left-and-right horizontal adjustment as would otherwise have to be effected most frequently and which would have been the most difficult manoeuvring. Therefore the operator has simply to perform at suitable times, while driving the vehicle, the manoeuvring to correct the height level of the scraper relative to the ground, as may vary and alter on account of pitching of the vehicle owing to undulations in the travelling direction of the vehicle, by means of raising and lowering the lift arms, and the manoeuvring to adjust the blade angle in proper accordance with the scraping soil volume and the soil property; thus enabling to quite remarkably enhance the manoeuvrability in contrast to the conventional tractors.

To be noted here further is that adjusting the raising and lowering of the lift arms is by means of the position-controlling, and is therefore far easier in its fine adjustment than by means of ON/OFF manipulation of the lever.

It has been demonstrated that the level-finishing to sufficiently good precision is attained with the tractor according to this invention simply be effecting the treatment twice or so, thus considerably enhancing the working efficiency.

The invention will now be further described with reference to the accompanying drawings which show, by way of example, an embodiment of tractor with a scraper for ground-levelling, according to this invention, and in which:

Fig. 1 is an overall side elevation;

Fig. 2 is an overall plan view;

Fig. 3 is a perspective view of a tractor body rear portion;

Fig. 4 is a rear end view, in vertical section, of a slant sensor;

Fig. 5 is a rear end view, in vertical section, of a lift-rod length detector;

Fig. 6 is an oilhydraulic circuit diagram;

Fig. 7 is a diagram of a driver circuit for electromagnetic controlling valves; and

Fig. 8 is a perspective view of a controlling box.

As shown in Figs. 1 and 2, rearwardly of a tractor proper or vehicle 1 there are mounted a pair of left and right lift arms 3 which are driven by a single-acting type oilhydraulic cylinder 2, to thus rockingly move them up and down as an integral unit, and there is provided a three-point link mechanism 6 consisting of a top link 4 and a left and a right lower links 5. The left and right lift arms 3 and lower links 5 are articulatedly interconnected on either side by means of the respective lift rods, 7 and 8. A ground-levelling scraper 9 of box-like shape is connected to the respective rear ends of the lower links 5 and the top link 4. In the illustrated specific embodiment,

the left-hand lift rod 7 is constructed as a double-acting type oilhydraulic cylinder, while the right-hand lift rod 8 is constructed as a turnbuckle which is adjustable in expansion and contraction, and the top link 4 is constructed also as a double-acting type oilhydraulic cylinder.

The ground-levelling scraper 9 is thus adapted to be driven for raising and lowering in its overall entirety by means of the lift-arm cylinder 2; to be actuated in left and right motion by cylinder 7; and to be modified in its fore-and-aft pitching slant posture by means of extension and contraction of the top link cylinder 4.

Looking further into the detailed construction of the ground-levelling scraper 9, with reference also to Fig. 3; it has, as its main constituent member, a transversely elongate box-like frame 10. In a front region of the frame there is transversely journalled a stay 12 with brackets 11 for articulated connection with the respective lower links 5. On this stay 12 there is securely attached an upright post 13 for articulated connection with the top link 4. Within the box-like frame 10 there is transversely journalled a frame 15 made of a rectangular section, to which a multiplicity of scarifiers 14 are juxtaposedly attached. To a rear-end lower rim portion of the box-like frame 10 there are attached a securely fixed blade 16 and a blade 17 for rearward running travel which is rockable in retraction rearwards and upwards. An oilhydraulic cylinder 18 is provided so as to rockingly drive the scarifier-attached frame 15, to thus manoeuvre the scarifier 14 in protrusion and retraction from a front-end lower region of the box-like frame 10. It is noted, however, that the ground-levelling work may as well be carried out even by substituting such a simple structure as a blade, for the more complicated scraper 9 as described above.

Reference is now made to Fig. 6 and the oilhydraulic controlling circuit illustrated for the oilhydraulic cylinders 2, 4, 7, 18 as hereinbefore mentioned.

Designated at 20 is a first flow-priority valve to receive pressurised oil supply from a pump 21 which is assumed to be driven by a tractor-mounted engine. It has a controlling port *a*, to send a constant rate of oil out of the pump supply, connected to an oilhydraulic controlling circuit of a non-illustrated forward-and-rearward-running-travel-change-over mechanism of the oilhydraulic clutch type; and a surplus port *b*, to send out the surplus oil, connected to a second flow-priority valve 22 which has, as illustrated, ports *c*, *d* corresponding to the respective ports *a*, *b* mentioned above. The port *c* is connected in serial manner to an electromagnetic controlling valve 23, which controls the actuation of the lift-rod cylinder 7, and another electromagnetic controlling valve 24 which controls the actuation of the top-link cylinder 4. Returning oil from these oilhydraulic serial electromagnetic valves 23, 24, via a check valve 28, is merged with the pressurised oil sent out from the port *d*. The merged pressurised oil, thus the reunited total oil of the surplus-oil output through the first flow-priority valve 20, is supplied to a further electromagnetic controlling valve 26 for the oilhydraulic cylinder 18 for the scarifier protrusion and retraction, and further thereafter the pressurised oil is supplied to a valve 27 controlling the position of the lift-arm cylinder 2.

The position-controlling valve 27 has its constituents: a main spool 30 and a poppet valve 31, which are interlocked with a position-controlling lever 29 via a spool-actuating lever 28; and an unloader valve 32. Thus, when the controlling lever 29 is rockingly manoeuvred, then the main spool 30 and the poppet valve 31 are accordingly shifted over and the lift arms 3 are raised or lowered. Such displacement of the lift arm 3 is transmitted via a feedback link 33 to the spool-actuating lever 28, so this position-controlling mechanism designated as a whole at 34, is such that when the lift arms 3 rise and lower to predetermined positions corresponding to the manoeuvring positions of the controlling lever 29, it then automatically halts same.

As illustrated, there is provided a control valve, as designated at 35, for the draft control during ploughing work, such that its oil path *e*, which is in communication with the lift-arm cylinder 2, is opened and closed in accordance with fore-and-aft rocking movement of a top-link bracket 37, that is attached to a rear face of a transmission case 40 via a tension bar 36, responsive to increase and decrease of the traction load; and that the lift arms 3 are then stably maintained in such a balanced state that the inner pressure of the lift-arm cylinder 2 corresponds properly to the present traction load value. To be noted here however, is the fact, that it is prerequisite, for actually effecting such draft control to always provide the pressurised oil to the lift-arm cylinder 2 from the position-controlling lever 27, therefore to set the position-controlling lever 29 as manoeuvred to its raising limit position. As is clear from the illustration, it is possible, by manoeuvring a draft-controlling lever 38 which is supposed to be disposed in juxtaposition to the position-controlling lever 29, to accordingly alter the displacement amount of the top-link bracket 37 when in the aforementioned balanced state, thus to adjust the traction load, namely the cultivation depth of the ploughing work. On the other hand, it is prerequisite, for effecting the position control of the lift arms 3, to always keep closed the draft-controlling valve 35, therefore to set the draft-controlling lever 38 as manoeuvred to its raising limit position.

The manner of mounting the aforementioned various controlling valves is best shown in Fig. 3 and is now described hereunder in some detail. To a rear portion upper surface of the transmission case 40 there is secured an upper lid case 41 accommodating therein the lift-arm cylinder 2 as seen in Fig. 1. The position-controlling valve 34 is attached on the inner surface of this lid case 41. The first flow-priority valve 20 is mounted to a left side of this lid case 41, with a spacer 42

interposed therebetween. To an outer side of this valve 20 there in turn is mounted a valve block 45 incorporating therein the second flow-priority valve 22, a main relief valve 43 and an auxiliary relief valve 44, which are shown in Fig. 6 and whose function is obvious therefrom without any particular comment. The electromagnetic controlling valve 26 for the scarifier protrusion and contraction is mounted directly on the upper surface of the valve block 45. The electromagnetic controlling valve 23 for the lift-rod cylinder and the electromagnetic controlling valve 24 for the top-link cylinder are mounted again on the upper surface of the valve block 45, with a plate 46 having oil paths therein interposedly inserted therebetween. It is supposed that the lid case 41 has an inlet port to receive the pressurised oil from the pump 21, that the pressurised oil is supplied therefrom to the first flow-priority valve 20 through an inner oil path, and that outlet ports of the electromagnetic controlling valves 23, 24, 26 are provided, all of them, on a rear-end surface of the valve block 45 and are pipe-connected to the corresponding oilhydraulic cylinders, 7, 4, 18 respectively.

As is seen from Figs. 7 and 8, the electromagnetic controlling valve 24, which is for the top-link cylinder 4 as described hereinbefore, and the electromagnetic controlling valve 26, which is for the oilhydraulic cylinder 18 for the scarifier protrusion and contraction, are manoeuvrable in forward-and-reverse shifting by means of manual switches 47, 48, respectively of the neutral-restoring type.

On the other hand, the electromagnetic controlling valve 23, which is for the lift-rod cylinder 7, is automatically controlled so as to maintain horizontal the ground-levelling scraper 9, in a manner as is described hereunder in some detail:

To the post 13 for the top-link jointing, there is mounted a sensor 50 adapted to detect the fact that the scraper 9 tilts or is transversely slanted from its horizontal posture beyond a predetermined range. As is shown in Fig. 4, this sensor 50 has a sensor case 51 containing therein an antifreezing liquid 52 of suitable viscosity. A transversely elongate float 54, for instance made of a plastic material and freely floating on the liquid, has, in its upper surface near both left and right end portions, magnetic-sensitive metal pieces 53. The case 51 is also equipped with a pair of proximity switches 55*a*, 55*b*, as are secured to left and right portions of its upper wall in such a fashion as are properly opposed to the respective metal pieces 53. As is thus obvious, if and when the scraper 9 tilts to the left or right beyond the predetermined insensitive range, then a respective metal piece 53 approaches sufficiently close to the corresponding proximity switch 55*a* or 55*b* and such condition is thus electrically sensed. It further is obvious that the sensor 50 may just as well be mounted on a part of the tractor proper, to result in similarly attaining the desired detection.

Reference is now made to Fig. 5 showing the lift-rod cylinder 7 in an enlarged scale. On the part of a cylinder casing 7*a*, there is mounted a switch case 57 accommodating therein a normally-closed type switch 56*a* and a normally-open type switch 56*b*; while on the part of a piston rod 7*b* there is mounted a switch-manoeuvring rod 58 mounted in the switch case 57 for free protrusion and retraction. The locational interrelation of these switches and the manoeuvring rod is such that when the lift-rod cylinder 7 is in a state of being balance in length with the right-hand lift rod 8, then only the normally-open type switch 56*b* is operated by the manoeuvring rod 58, as in the drawing, and when departing from this state towards the retraction side then both the switches 56*a*, 56*b* are commonly operated by the manoeuvring rod 58, while when departing towards the protrusion side then the rod 58 moves away from both the switches 56*a*, 56*b*.

Referring back to Figs. 6 and 7, a normally-open type switch 59 is disposed in the vicinity of the position-controlling lever 29 so as to be actuated by the movement thereof for sensing the fact that the lever 29 is within a predetermined manoeuvring range near the lift-arm raising limit. Another normally-open type switch 60 is disposed in a corresponding manner in the vicinity of the draft-controlling lever 38, which in turn is disposed as mentioned above in juxtaposition to the position-controlling lever 29, for similarly sensing the fact that the lever 39 is within a predetermined manoeuvring range near the raising limit.

As is seen in Fig. 7, the proximity switches 55*a*, 55*b*, the pair of switches 56*a*, 56*b* for the cylinder-position detection, and the switches 59, 60 for the lever-position detection, are electrically incorporated in a controlling circuit for driving solenoids 61*a*, 61*b*, respectively on the cylinder contraction and extension sides, of the electromagnetic controlling valve 23 for the lift-rod cylinder 7. At 62 is a main switch, at 63 is an AUTO/MANUAL mode-shifting switch, and at 64 is an automatically neutral-restoring type manual switch for manually actuating, in extension and contraction, the lift-rod cylinder 7. This circuit, incorporating the various switches as mentioned, is incorporated in a control box 67 which is illustrated in Fig. 8 and which is attached to an upper surface of a rear-wheel fender 66; in the illustrated instance at the right-hand side of an operator's seat 65 of the tractor 1, as shown in Fig. 2. The seated operator may thus conveniently operate the switches while rearwardly turning the body in a posture to watch the ground-levelling scraper 9.

Operation of the control circuit is now described in some detail.

When automatic horizontal control of the ground-levelling scraper 9 is desired, the working height level of the scraper 9 is suitably set by means of properly manoeuvring the position-controlling lever 29; the main switch 62 is turned on; and the mode-shifting switch 63 is set in

"AUTO" position.

Under proper setting as above, if and when the scraper 9 is in the left-and-right horizontal posture, then both the proximity switches 55*a*, 55*b* of the slant-sensor 50 are respectively off, with their output commonly in "H", i.e. logical HIGH, thus to result in that the outputs of AND gates A_1, A_2 are both "L", i.e. logical LOW. Besides, since the position-controlling lever 29 is not within its maximum raising range, the switch 59 is open. Therefore, outputs of the OR gates R_1, R_2 are "L", output of another OR gate R_3 is "H", and output of other AND gates A_4, A_5 for triggering the respective transistors are "L"; so neither of the solenoids 61*a*, 61*b* is energised and the electromagnetic controlling valve 23 is held in neutral.

If and when the vehicle 1 tilts to the left in a rising slant beyond the predetermined sensitive range angle, then the right-hand proximity switch 55*b* alone is turned on in the sensor 50, and its output is thus shifted to "L". In consequence thereof, the output of the AND gate A_2 is shifted to "H", and so the output of the OR gate R_2 also shifts to "H". Since the output of the AND gate A_3 here remains to be "H", the output of the AND gate A_5 for triggering the transistor becomes "H". Accordingly, the solenoid 61*b* is energised and so the electromagnetic controlling valve 23 is shifted over to extend the lift-rod cylinder 7, thus to the slant-correcting side, namely to urge the scraper 9 to restore its horizontal posture. As so urged, when the scraper 9 is thus restored to come back within the present horizontal range, the proximity switch 55*b* is turned off and so the controlling valve 23 is restored to neutral and the extending actuation of the cylinder 7 thus ceases.

Conversely, if and when the vehicle 1 tilts leftwards in a descending slant, then the left-hand proximity switch 55*a* alone is turned on in the sensor 50, and accordingly the solenoid 61*a* is energised and the cylinder 7 is actuated in contraction until the scraper 9 is restored to come back within the present horizontal range.

As is thus clear from the above, the scraper 9 is maintained horizontal, regardless of any tilting in the left-and-right slant of the vehicle 1.

On the other hand, while retaining this "AUTO" mode, if the scraper 9 is raised up by manoeuvring the position-controlling lever 29 to the raising limit, then the switch 59 is turned on by means of the lever 29. In this instance, since it is here supposed, as mentioned above as prerequisite conditions, that the switch 60 has previously been turned on by means of the draft-controlling lever 38, the output of the OR gate R_3 is then caused to alter in accordance with the actuation status of the switches 56*a*, 56*b* for the respective cylinder-position detection.

At the time when the switch 59 is turned on as mentioned above, suppose first that the lift-rod cylinder 7 is then in a state to be shorter than the right-hand lift rod 8, namely that the scraper 9 is in the leftwards uprising state. In such a case, both the switches 56*a*, 56*b* are actuated by the rod 58, thus the switch 56*a* is cut open and the switch 56*b* is made closed. Accordingly, the output of the switch 56*a* in such case is "L" and the output of the switch 56*b* is "H". In consequence, the solenoid 61*b* is energised, and so the lift-rod cylinder 9 is actuated in extension. The extension thus continues until a state where the switch 56*b* alone remains abutted on by the manoeuvring rod 58, whereupon the outputs of both the switches 56*a*, 56*b* become commonly to "H". In consequence, the output of the OR gate R_3 and further the output of the AND gate A_3 come to "L", and thus the output of the AND gate A_5 accordingly shifts over to "L". Therefore, the solenoid 61*b* is deenergised, and so the controlling valve 23 is restored to neutral. Thus, automatic adjustment is effected such that the left and right lift rods 7, 8 have the same length and the scraper 9 is secured in its posture of such left and right even height levels relative to the vehicle 1. Contrary to the first supposition as above, suppose secondly that at the time when the switch 59 is turned on, the lift-rod cylinder 7 is then in a state to be longer than the right-hand lift rod 8, namely that the scraper 9 is in the leftwards descending state. In such a case, both the switches 56*a*, 56*b* commonly come to the manoeuvring rod 58, thus the switch 56*a* is made closed and the switch 56*b* is cut open. In this case, the solenoid 61*a* alone is energised, and so the lift-rod cylinder 7 is actuated in contraction. The contraction thus goes on until the state where the switch 56*b* alone is abutted on by the manoeuvring rod 58 and is thereupon halted in a manner just the same as in the first-supposed extension case.

As is thus seen, if and when the scraper 9 is raised to a great extent in order for instance to turn around the vehicle at the end portion of the working field, then the scraper 9 is automatically sustained in its posture parallel to the vehicle base, with the left and right height levels relative to the vehicle 1 being the same and even.

When manual control of the scraper posture is desired, without any automatic control functioning, then the mode-shifting switch 63 is set or shifted to "MANUAL" position. Then the output of the AND gate A_3 comes to "L" and so the outputs of the AND gates A_4, A_5 are maintained to be "L" regardless of the signals from the sensor 50, and therefore the controlling valve 23 may now be actuated only by means of the ON/OFF manoeuvring of the manual switch 64.

The construction according to this invention may be modified, for example, as follows:

Electrical sensing means for instance of the potentiometer type may be provided for sensing the manoeuvring position or state of the position-controlling lever 29 and the rocking angle of the lift arms 3, to thus provide an electric type position-controlling mechanism.

The left-and-right slanting sensor 50 may be of the analog-output type and may be mounted on a part of the vehicle 1; and the lift-rod cylinder 7